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AUTHOR Ramsberger, Peter F.; And Others
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ABSTRACT

One of a series of developmental projects that have produced and evaluated applications of an advanced multimedia, computer-based technology for basic skills education for Army enlisted personnel, this project focused on the development of an integrated curriculum to teach learning strategies and problem-solving skills. The first task was to develop interactive videodisc instruction in problem solving and grouping as a learning strategy (i.e., classifying information into groups that emphasize similarities between items), and to produce a videodisc overview to integrate this instructional package with 12 previously produced videodiscs that teach a variety of additional study skills and learning strategies. The second task was to prepare printed, off-line materials to teach the skills presented in the entire videodisc curriculum for use both in future media comparison evaluations planned by the Army Research Institute (ARI), and in locations that do not have the hardware necessary to present videodisc instruction. The third task was to prepare two videotapes, one a short summary and the other a 20-minute presentation, of the videodisc work sponsored by ARI. All videodisc instruction was designed for use with Apple- and Cromemco-based Spatial Data Management Systems (SDMS). This report presents a discussion of the learning strategies curricula, including its purpose, the videodisc materials that were developed, design and development issues, and the development of off-line materials, and a description of the videotape presentations on ARI videodisc instructional projects. Four tables provide supporting information, and seven references are listed. (JB)

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Development of Parallel Learning Strategies Curricula Using Videodisc and Standard Off-Line Formats

Peter F. Ramsberger, Carolyn Dellinger Hanks, and C. Wesley Kowal
Human Resources Research Organization

David Hopwood
Video Software Associates, Incorporated

HUMAN RESOURCES RESEARCH ORGANIZATION
1100 South Washington Street • Alexandria, Virginia 22314-4499

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The Department of Defense (DOD) initiated programs to implement the Defense Science Board Summer Study (1982) recommendations for emphasis on the application of advanced technology for training, collection and analysis of data on cost and effectiveness of training, and enhanced transfer of instructional technology. The objectives of this project in support of the DoD initiatives were to: (1) develop interactive videodisc instruction for Army enlisted personnel to learn problem solving strategies and include it and the previous videodisc lessons in an integrated learning strategies curriculum, (2) develop a parallel curriculum in a standard paper-pencil format for use at locations without videodisc equipment and to facilitate future media comparisons in evaluations planned by the US Army Research Institute (ARI), and (3) create a videotape presentation of the videodisc instruction that has been sponsored by ARI.

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Since 1980, HumRRO has conducted research and development to produce and evaluate applications of an advanced multimedia, computer-based technology for basic skills education, which included 12 videodiscs for interactive instruction. That work indicated the need for an integrated curriculum to teach learning strategies and problem solving skills to enlisted personnel. To meet that objective, the first task of this project was to develop interactive videodisc instruction in problem solving skills and to design a video overview as a link among the various lessons. To provide a parallel form of instruction and to support further evaluations, the second task was the preparation of printed, off-line materials for all of the lessons. The last task was the production of two videotapes, one a short summary and the other a twenty-minute presentation of the videodisc work that ARI has sponsored.

The products of this developmental project were: two videodiscs and the related instructional software to train problem solving strategies and grouping as a learning strategy to Army personnel, and an overview to integrate the entire learning strategies curriculum; a parallel curriculum of off-line materials for use in locations without the needed hardware for videodisc presentation and for a media comparison evaluation; and, a set of videotapes to describe ARI videodisc instructional projects.

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DEVELOPMENT OF PARALLEL LEARNING STRATEGIES CURRICULA USING VIDEODISC AND STANDARD OFF-LINE FORMATS

EXECUTIVE SUMMARY

The Department of Defense (DoD) initiated programs to implement the Defense Science Board Summer Study (1982) recommendations for emphasis on the application of advanced technology for training, collection and analysis of data on cost and effectiveness of training, and enhanced transfer of instructional technology. The objectives of this project in support of the DoD initiatives were to: (1) develop interactive videodisc instruction for Army enlisted personnel to learn problem solving strategies and include it and the previous videodisc lessons in an integrated learning strategies curriculum, (2) develop a parallel curriculum in a standard paper-pencil format for use at locations without videodisc equipment and to facilitate future media comparisons in evaluations planned by the US Army Research Institute (ARI), and (3) create a videotape presentation of the videodisc instruction that has been sponsored by ARI.

Since 1980, HumRRO has conducted research and development to produce and evaluate applications of an advanced multimedia, computer-based technology for basic skills educations, which included 12 videodiscs for interactive instruction. That work indicated the need for an integrated curriculum to teach learning strategies and problem solving skills to enlisted personnel. To meet that objective, the first task of this project was to develop interactive videodisc instruction in problem solving skills and to design a video overview as a link among the various lessons. To provide a parallel form of instruction and to support further evaluations, the second task was the preparation of printed, off-line materials for all of the lessons. The last task was the production of two videotapes, one a short summary and the other a twenty-minute presentation of the videodisc work that ARI has sponsored.

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DEVELOPMENT OF PARALLEL LEARNING STRATEGIES CURRICULA
USING VIDEODISC AND STANDARD OFF-LINE FORMATS

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INTRODUCTION

The Department of Defense (DoD) has implemented programs to enhance the transfer of instructional technology to improve military training. Army initiatives include research and development by HumRRO to evaluate techniques for interactive videodisc instruction in Army basic skills education, and a joint effort by ARI, the Army Training and Doctrine Command (TRADOC), and schools in TRADOC to establish field activities for technology transfer.

Since 1980, HumRRO has conducted research and development to produce and evaluate applications of an advanced multimedia, computer-based technology for basic skills education. A low-cost, microprocessor-controlled videodisc system is the core development and delivery system. This system was selected on the basis of a projective cost and training effectiveness analysis (Seidel and Wagner, 1983).

For many recruits entering the Army, particularly those enrolled in the Basic Skills Education Program (BSEP), functioning successfully in an academic environment is a continual problem. Many of these same recruits are not fully aware of the extent to which test-taking skills are important to their Army careers. Virtually every military occupational specialty (MOS) requires that skill qualification tests (SQT) be administered. In many MOS these tests affect grade or rank. The previous videodisc project was carried out within the following contexts: concern for improved test-taking and related skills, need to provide a study procedure with emphasis on the steps involved in locating the necessary information to be studied, and learning strategies as a means to organizing the information. Ramsberger, Hopwood, Hargan, and Underhill (1986) reported the principles and techniques applied in design and production of the instructional materials, including the videodiscs for use with the Spatial Data Management System (SDMS). Twelve videodiscs were produced that train a variety of study skills, test taking strategies, spatial orientation and navigation, and other learning strategies. Laboratory and field experiments evaluated the effectiveness of the materials. In general, the spatial orientation and navigational skills training was effective regardless of the learning strategies trained (Ramsberger, Sticha, Knerr, Elder, Rosenblatt, Paris, Wagner, and Leopold, 1984).

LEARNING STRATEGIES CURRICULA

Purpose

The need for an integrated curriculum to teach learning strategies and problem solving skills to enlisted personnel followed from the work described above. Thus, the first task in this project was to develop and produce interactive videodisc instruction for problem solving skills and grouping as a learning strategy (classifying information into groups that emphasize similarities between items), and to produce a videodisc overview to integrate the entire videodisc instruction. Second, to support further evaluation of the instruction, printed, off-line materials were to be prepared. These materials were to teach the same skills that were presented in the new and previous HumRRO-produced videodisc instruction. In addition to facilitating future media comparisons in evaluations planned by ARI, these off line materials offer a paper-and-pencil version of the same instruction to locations that do not have the hardware necessary for presentation of the videodisc instruction. The third task was to prepare two videotapes, one a short summary and the other a twenty-minute presentation, of the videodisc work that ARI has sponsored (conducted by HumRRO and other organizations).

Table 1 provides a concise reference to the reports which contain detailed information for the previous work as well as the currently completed project. Table 2 presents a complete videodisc summary.

Videodisc Materials

A goal of the project was to develop interactive videodisc instruction on strategies to improve the soldier's learning and problem solving skills. Toward this goal, we organized the strategies related to learning and problem solving into an integrated curriculum for interactive videodisc instruction. All videodisc instruction was designed for use with the SDMS system. Table 3 lists the equipment components of the Cromemco and Apple-based systems.

Under a previous contract (MDA-903-91-C-0083) a number of lessons on learning strategies and test taking skills were developed. These include the following:

- Study skills--Preparing for the written Skill Qualification Test (SQT)
- Test Wiseness--Taking multiple choice tests
- Relaxation and Positive Self-Talk--Coping with test anxiety

Table 1

Reference Guide to Previous and Current
Videodisc Projects Areas of Interest

Title	Area of Interest
Evaluation of a Spatial Data Management System for Basic Skills Education (Seidel & Wagner, HumRRO Interim Report 83-21, 1983) Interim Report 83-21, 1983)	design and development issues videodisc content field test and laboratory experiments cost and training effectiveness study
Spatial Data Management System for Basic Skills Education (Ramsberger, Hopwood, Hargan, & Underhill, ARI Research Note RN-86-in press, 1986)	literature review computer system and software descriptions design,development,production, and programming of 12 videodiscs case study of project first phase
Evaluation of a Spatial Data Management System for Basic Skills Education (Ramsberger, Sticha, Knerr, Elder, Rosenblatt, Paris, Wagner, & Leopold, ARI Research Note RN-84-128, 1984)	literature review learning strategies and learner control issues and experiments effectiveness of videodisc instruction in learning strategies analysis of 6 microcomputers checklist for evaluation of new technology
Development of Interactive Videodisc Instruction for Problem Solving and Armor Skills: Volumes I and II (Knerr, Ramsberger, Harris, Wetherby, Hannaman, Hopwood, Burnside, & Phelps, ARI Research Note RN-86-in press, 1986)	learning strategies curriculum Ft. Knox TTFA and 19K BNCOC off-line evaluation materials

Table 2

Videodisc Summary

Title	No. of Discs	Summary of Contents
<u>Previous Project</u>		
Prototype	2	- Opening - SDMS and vicarious travel - Orientation to a line - Shadow-tip method of determining direction - Terrain visualization - Vicarious travel on the Mall - Angle pool game - Table of contents
Study Skills and Test-Taking Strategies	4	- Preparing for the written SOT - Test-taking skills - Test anxiety reduction (physical relaxation and positive self-talk)
Spatial Orientation and Navigational Skills	3	- Learning strategies (imagery, partitioning and selective attention) - Learning units on direction finding (cardinal directions, use of sun, shadows, and landmarks) - Games and simulated travel exercises - Tests
Learning Strategies	3	- Information processing techniques - Active rather than passive learning - Alternative representations of material (flowcharts, mnemonics, pictures, etc.) - Practice exercises
<u>Current Project</u>		
Overview	2	- Brief description of materials in package (and potential benefits)
Grouping Strategy		- Grouping - Segmenting - Sequencing (revised partitioning as learning strategy)
Problem Solving Skills		- Attending to relevant information - Generating alternate solutions - Evaluating solutions

Table 3

Equipment Components of SDMS System

Apple-Based SDMS	Cromemco-Based SDMS
1. Bell & Howell Black Apple, (modified to include 16K Memory Board, 2 I/O Boards Softcard Z80, Disk II Controller Card, & Videx 80 Column Board) Bell & Howell Black Apple Disk Drive	1. Cromemco Basic System (includes 96K CPU and Dual Disk Drives)
2. Pioneer Videodisc Player	2. Pioneer Videodisc Player
3. 13 inch color TV monitor	3. 12 inch color TV monitor
4. 13 inch B/W TV monitor	4. 12 inch B/W TV monitor
5. Keyboard	5. Keyboard
6. Joystick	6. Joystick

- Grouping--Using partitioning to organize and learn information
- Imagery--Applying mental imagery to learning skills
- Learning Strategies--Techniques for becoming an active learner

A review of these materials resulted in the decision to make the additions and alterations required to form a learning strategies package for the Basic Skills Education Program (BSEP). Given certain time and budgetary constraints, it was agreed that the following elements would be developed:

- Addition of an overview to the package for informational and motivation purposes
- Reworking of the grouping and partitioning materials based on results achieved from evaluation research
- Addition of a module on problem solving to emphasize independent thinking skills.

What follows is a more complete description of the units developed as part of this phase of the project.

Overview. The purpose of this unit was twofold: To provide the soldier with a rationale and framework for the instruction

and to instill a motivational set conducive to a successful learning experience. Because of the "preview" nature of this piece there was an extensive use of footage from the other programs in the series. The central points covered include the following:

- A soldier in today's Army must learn a good deal of information to be successful.
- People have trouble learning because they go about it in the wrong way.
- These materials will show the right way to learn.
- Going through these materials will be a new and enjoyable experience.

This segment is non-interactive and has a play time of approximately three and one-half minutes.

Grouping. As part of earlier work in the area of spatial orientation and navigation skills, a lesson was developed on the use of partitioning as a learning strategy. Preliminary research results indicated that subjects felt the strategy was a useful one. The major problem with incorporating the unit into a general learning strategies package was the degree to which the strategy was taught using navigation facts and skills as the content matter. Therefore, the lesson was refined employing a more general focus.

The format for the delivery of the instruction emphasized three elements of partitioning. Grouping organizes the information in ways which emphasize similarities between items classified together. For instance, aircraft can be grouped into fixed and rotary wing, shape of tail, shape of wing, etc. Segmenting breaks up the steps in a procedure or set of instructions into smaller, more easily remembered pieces. The steps involved in jump starting a car for example, can be divided into the preparation phase, placement of cables and start up of the cars. Finally, sequencing orders the information in logical ways which, again, facilitates memory. In putting on an M-17 series protective mask, for instance, the steps involved flow logically from one to the next. Concentrating on this logic will aid the learning process. This unit of instruction explains each of these three processes, gives examples, and includes exercises with content relevant to the military. The linear play time of this piece is about 10 minutes; with interaction a soldier completes it in 25 to 30 minutes.

Problem solving. A survey of the learning strategies materials developed under the previous contract revealed a gap in the area of independent thinking skills. The strategies taught in previous materials focused on standard learning tasks such as using manuals and attending lectures. Clearly an important skill

for soldiers to develop is that of being able to think in a logical manner when confronted with situations for which there is no prescribed standard operating procedure. These situations can, in one sense, be seen as requiring problem solving or decision making abilities.

One of the difficulties encountered in developing materials on problem solving is the complexity of such skills and the limited videodisc space and training time available to teach them. Therefore, a primary goal was to make sure that the instructional objectives were realistic and achievable given the target population and the limited amount of training time.

A survey of the existing problem solving courses and research (for instance, Wickelgren, 1973; Rubenstein, 1975) uncovered three fundamental principles which were consistently emphasized as being central to the effective application of such skills. These principles were the core of the instructional materials. They are:

- Attend to all information relevant to the situation at hand, while ignoring that which is irrelevant or less important.
- Generate a variety of solutions to the problem; don't simply select the most obvious course of action.
- Think through the solutions arrived at, attending to the positive and negative consequences of each.

For the soldier the application of these skills may be most vital in the battlefield environment; thus part of the instruction focused on tactical situations. At the same time, the importance of emphasizing the potential value of a more generalized application of these principles was acknowledged. Therefore, the instruction took a two-pronged approach showing the characters as they develop their problem solving skills in both tactical and non-tactical environments.

The main body of the lesson is approximately 30 minutes long (linear play time), and is divided into three parts, each emphasizing one of the principles outlined above. Each segment has an interactive exercise. In the major exercise, incorporating all three of the principles, the student sees a character in a simulated battle where he faces a series of problems. Alternate solutions are presented to the student, who must evaluate them and select the one he/she believes is best. Feedback explains why the solution chosen is or is not the best choice. This feedback places strong emphasis on the principles presented during the instructional portion of the program. A scoring option employs both the number of incorrect responses and the speed with which decisions were made in deriving a final total. These exercises take from 20 to 30 minutes to complete.

Design and Development Issues

The development of the units described above followed a general design and production procedure which is summarized below.

Design	Development of objectives Formulation of approach (treatments) Review of objectives and treatments by sponsor
Development	Drafting scripts Revision of scripts (resulting in shooting scripts) Review of scripts by sponsor Revision of scripts based on sponsor input
Production	Production of art work, selection of shooting sights, etc. Filming Editing Sponsor review of edited materials Revision based on sponsor input Miscellaneous post-production activities (film to tape transfer, sound mix, etc) Mastering of videodiscs
Programming	Programming of Videodiscs Sponsor review of computer software Revision of computer software

The Design and Production phases of the problem solving unit were found to provide unique challenges associated with the fact that an attempt was being made to simulate battlefield conditions and scenarios. Should this type of undertaking be attempted in the future, these considerations are likely to come up again. For that reason, three of the primary issues involved in design and production are presented here.

Developing scenarios. The development of the tactical scenarios presented one of the greatest challenges during the design phase. The situations must be realistic, with non-trivial and non-obvious solutions. At the same time, recommended solutions had to be acceptable militarily, conforming to any and all applicable Army doctrine.

The procedure for developing scenarios began with an individual with years of actual and simulated battlefield experience drawing storyboards based on "real life" experiences in the field. Production and design staff then reviewed the storyboards, and selected those incidents which could most easily be presented in a linear format and which could most feasibly be

produced given time and budget constraints. Scripts were then written and reviewed by military subject matter experts provided by the sponsor. All issues raised during this review were resolved by revising the script or providing a more complete explanation of the material in question.

Despite this thorough review process, disagreements have still arisen during demonstrations of these exercises to military personnel. It seems clear that no matter what steps are taken to avoid controversy, there will most likely be some disagreement, no matter how minor, about the situations presented or the solutions recommended. By using a critical incident technique such as the one employed here, however, these disagreements can be held to a minimum.

Designing interaction for simulations. Another key issue during the design phase had to do with student inputs and feedback. The central questions concerned how to design the interaction in such a way that students could actually generate and enter solutions, and how to provide feedback which would show the consequences of actions taken. Because of the limited nature of the four-button input device, there was no way to have soldiers key in alternatives which were independently derived. As a result, a standard menu, listing alternatives to be selected from, was used. Future work could capitalize on speech recognition capabilities which exist with many newer computer systems, allowing the soldiers to generate their own solutions and enter them directly into the system. This capability will be a major step in the development of videodisc-based simulations.

The problem with showing students the consequences of their choices is twofold: Achieving agreement on what would result from a given decision, and limitations on disc space which would quickly be used up if students were shown outcomes or allowed to follow a "wrong" path for any appreciable length of time. Thus, this instruction does not actually show decision outcomes, but rather describes briefly the problems with a given solution, emphasizing the three principles which form the core of the lesson. Future work in this area might involve systems with multiple videodisc players, thereby increasing the amount of disc space that can be devoted to a single problem. "Wrong" paths could then be followed in ways judged to be most likely by subject matter experts.

Production. One of the chief concerns with any video production involving military situations and environments is with the visual accuracy of the events and people depicted. A single small mistake in costumes, terminology, etc., can damage the credibility of the entire program. This fact was critical in this lesson because of the complexity of representing a battlefield environment. Therefore, two steps were taken to eliminate any potential problems in this regard. First, the battlefield scenarios were depicted as envisioned by one of the characters in the program: the events and people are not

represented as being real, they are pictured as our character imagines them. This use of fantasy avoided a number of issues which might have caused problems (e.g., identification of the enemy force).

The second safeguard used well-trained soldiers both on camera as extras and off camera as advisors. When questions arose during filming concerning specific points of military doctrine, there were knowledgable people at hand to answer them.

Off-Line Materials

The goal in developing the off-line materials was to have them parallel the content of the videodisc lessons as closely as possible. The objectives for each of the lessons were retained along with the content matter and general structure of the exercises. The changes required by the shift of medium related to the manner in which the instruction itself was presented. The videodisc materials depended heavily on characters who, in interacting with one another, described and demonstrated the strategies of interest. The transfer to paper and pencil format necessitated adopting a more straightforward approach, with the soldier being "addressed" directly in the instruction. The design and development decisions centered on heavy use of graphics and an uncluttered page format. An additional concern was with the readability levels. The materials, which were subjected to the readability formulas of Fry[1] and Raygor[2] indicated reading levels at the sixth grade.[3] Glossaries were included in four of the lessons where the vocabulary was judged to be more difficult. The draft off-line materials went through internal review and revision before delivery to ARI for review, revision, and approval. The final set of materials included the following handbooks which were presented in the HumRRO interim report for this task (Knerr, et al., 1986):

Study Skills Handbook
Test Wiseness - Tips for Taking Multiple Choice Tests
Relaxation Handbook
Relaxation Home Practice
Positive Self-Talk
Imagery Handbook

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[1]Edward Fry, Rutgers University Reading Center, New Brunswick, NJ 08804.

[2]Alton L. Raygor, University of Minnesota, 192 Pillsbury Drive S.E., Minneapolis, MN 55455.

[3]The range was from early to late sixth grade reading level equivalent.

Grouping Handbook
Learning Strategies Handbook
Problem Solving Handbook

Table 4 shows a comparison of the content of the off-line materials to the videodisc instruction.

The research plan developed for evaluating the Basic Skills Learning Strategies Package called for one experimental group (those subjects receiving the videodisc-based training), and two control groups. The first control group would receive no learning strategies instruction, while the second group would go through the off-line materials described above. The actual evaluation research reverted to ARI for completion.

Table 4

Comparison of Instruction Available on Videodisc and Off-Line Materials

Videodisc Title (No. of Discs)	Summary of Contents	In Off-Line Materials?	Off-Line Materials Title
Study Skills and Test-Taking Strategies (4)	- Preparing for written SQT	yes	Study Skills Handbook
	- Test-taking skills	yes	Test Wiseness - Tips for Taking Multiple Choice Tests
	- Test anxiety reduction (physical relaxation and	yes	Relaxation Handbook Relaxation Home Practice booklet
	positive self-talk)	yes	Positive Self-Talk
Spatial Orientation and Navigational Skills (3)	- Learning strategies (imagery, partitioning and selective attention)	yes yes no	Imagery Handbook Grouping Handbook
	- Learning units on direction finding (cardinal directions, use of sun, shadows, and landmarks)	no	
	- Games and simulated travel exercises	no	
	- Tests	no	
Learning Strategies (3)	- Information processing techniques	yes	Learning Strategies Handbook
	- Active rather than passive learning	yes	
	- Alternative representations of material (flowcharts, mnemonics, pictures, etc.)	yes	
	- Practice exercises	yes	
Problem Solving Skills (2)	- Attending to relevant information	yes	Problem Solving Handbook
	- Generating alternate solutions	yes	
	- Evaluating solutions	yes	

VIDEOTAPE PRESENTATION

ARI receives many requests from military and non-military sources to explain and demonstrate its current projects. To inform those interested in the implications of interactive video, "Training for Tomorrow," a 20-minute videotape, as well as a 7-minute executive summary version, were created. These tapes describe ARI's pioneering involvement in research projects designed to study the feasibility of using interactive video training to improve Army readiness. The projects described were undertaken from the late '70s to 1984. These projects ranged from the beginning stages of research and development to experimental implementation.

The tapes explain that ARI has long been involved in computer-based instructional systems. The primary thrust of the research in interactive video was to find out if adding random access video, realistic modeling, and other unique interactive features would make learning effective as well as highly motivating.

A brief opening introduces the need for advanced training technologies in light of the personnel needs as specified in current Army fighting doctrines. A voice-over narration then describes the projects and their findings. Among the projects featured are those involving basic skills education, technical training, leadership and interpersonal skills, land and aerial navigation, fire control and gunnery, and problem solving. The visuals include segments from the videodiscs and students using the instructional systems. Each tape ends by quoting a Washington Post editorial on interactive video:

> The enormous advantage of this kind of training is that it can adjust automatically to the skill level and learning speed of each individual student, check progress automatically, and eliminate the need for expensive machinery.

Viewers of the tapes learn that, though pilot projects are still in progress, the results so far reveal that interactive video systems have shown themselves to be cost-effective, especially when coupled with hands-on training. Copies of the 20-minute tape and the shorter 7-minute executive summary have been made in various formats for distribution in the United States and overseas.

RESULTS AND CONCLUSIONS

The products of this developmental project were: one videodisc and the associated instructional software to train problem solving strategies and grouping as a learning strategy to Army personnel, and an overview to integrate the entire learning strategies curriculum; off-line materials for use in locations without the needed hardware for videodisc presentation and for a media comparison evaluation; and, a set of videotapes to describe ARI videodisc instructional projects.

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